

CLAIMS

What is claimed is:

1. A computerized method of virtualizing graphics resources comprising:
 - receiving, by a graphics kernel, an allocation request for a graphics resource from a graphics client;
 - allocating, by the graphics kernel, the graphics resource to the graphics client;
 - returning, by the graphics kernel, an address for the graphics resource to the graphics client;
 - receiving, by the graphics kernel, a command from the graphics client specifying the address; and
 - managing, by the graphics kernel, the graphics resource.
2. The computerized method of claim 1, wherein managing the graphics resource comprises:
 - determining if the graphics resource is available; and
 - paging current data associated with the graphics resource to a backing store if the graphics resource is not available.
3. The computerized method of claim 2, wherein the current data to page is determined using paging criteria.
4. The computerized method of claim 3, wherein the paging criteria is selected from the group consisting of a type of graphics resource, a priority, and a paging algorithm.
5. The computerized method of claim 4, wherein the paging algorithm is based on usage of the graphics resource.

1 6. The computerized method of claim 1, wherein managing the graphics resource
2 comprises:

3 detecting a conflict if the graphics resource represented by the token has been
4 reused; and
5 resolving the conflict.

1 7. The computerized method of claim 6, wherein resolving the conflict comprises:
2 inserting a reference to a graphics hardware semaphore before the command;
3 paging the current data associated with the graphics resource to the backing store;
4 paging data for the graphics client from the backing store into the graphics resource;
5 and
6 clearing the graphics hardware semaphore.

1 8. The computerized method of claim 1 further comprising:
2 recording, by the graphics kernel, information about the graphics resource in an
3 entry in a virtualization map for use in allocating and managing graphics resources.

1 9. A machine-readable medium having executable instructions to cause a processing
2 system to perform a method comprising:
3 receiving, by a graphics kernel, an allocation request for a graphics resource from a
4 graphics client;
5 allocating, by the graphics kernel, the graphics resource to the graphics client;
6 returning, by the graphics kernel, an address for the graphics resource to the
7 graphics client;
8 receiving, by the graphics kernel, a command from the graphics client specifying the
9 address; and
10 managing, by the graphics kernel, the graphics resource.

1 10. The machine-readable medium of claim 9, wherein managing the graphics resource
 2 comprises:
 3 determining if the graphics resource is available; and
 4 paging current data associated with the graphics resource to a backing store if the
 5 graphics resource is not available.

1 11. The machine-readable medium of claim 10, wherein the current data to page is
 2 determining using paging criteria.

1 12. The machine-readable medium of claim 11, wherein the paging criteria is selected
 2 from the group consisting of a type of graphics resource, a priority, and a paging algorithm.

1 13. The machine-readable medium of claim 12, wherein the paging algorithm is based on
 2 usage of the graphics resource.

1 14. The machine-readable medium of claim 9, wherein managing the graphics resource
 2 comprise:
 3 detecting a conflict if the graphics resource has been reused; and
 4 resolving the conflict.

1 15. The machine-readable medium of claim 14, wherein resolving the conflict
 2 comprises:
 3 inserting a reference to a graphics hardware semaphore before the command;
 4 paging the current data associated with the graphics resource to the backing store;
 5 paging data for the graphics client from the backing store into the graphics resource;
 6 and
 7 clearing the graphics hardware semaphore.

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1 16. The machine-readable medium of claim 9, wherein the method further comprises:
2 recording, by the graphics kernel, information about the graphics resource in an
3 entry in a virtualization map for use in allocating and managing graphics resources.

1 17. A processing system comprising:
2 a processor coupled to a memory through a bus;
3 a graphics processor coupled to the processor through the bus and associated with
4 graphics resources; and
5 a kernel driver executed by the graphics processor to cause the graphics processor
6 to
7 receive an allocation request for a graphics resource from a graphics client,
8 allocate the graphics resource to the graphics client,
9 return an address for the graphics resource to the graphics client,
10 receive a command from the graphics client specifying the address, and
11 manage the graphics resource.

1 18. The processing system of claim 17, wherein the kernel driver, when managing the
2 graphics resource, further causes the graphics processor to
3 determine if the graphics resource is available, and
4 page current data associated with the graphics resource to a backing store if the
5 graphics resource is not available.

1 19. The processing system of claim 18, wherein the current data to page is determined
2 using paging criteria.

1 20. The processing system of claim 19, wherein the paging criteria is selected from the
2 group consisting of a type of graphics resource, a priority, and a paging algorithm.

1 21. The processing system of claim 20, wherein the paging algorithm is based on usage
2 of the graphics resource.

1 22. The processing system of claim 17, wherein the kernel driver, when managing the
2 graphics resource, further causes the graphics processor to
3 detect a conflict if the graphics resource has been reused; and
4 resolve the conflict.

1 23. The processing system of claim 22, wherein the graphics processor is associated
2 with a graphics hardware semaphore, and the kernel driver, when resolving the conflict,
3 further causes the graphics processor to
4 insert a reference to the graphics hardware semaphore before the command,
5 page the current data associated with the graphics resource to the backing store,
6 page data for the graphics client from the backing store into the graphics resource,
7 and
8 clear the graphics hardware semaphore.

1 24. The processing system of claim 17, wherein the kernel driver further causes the
2 graphics processor to record information about the graphics resource in an entry in a
3 virtualization map for use in allocating and managing graphics resources.

1 25. A graphics system comprising:
2 a graphics processor associated with graphics resources; and
3 a kernel driver executed by the graphics processor to cause the graphics processor
4 to
5 receive an allocation request for a graphics resource from a graphics client,
6 allocate the graphics resource to the graphics client,
7 return an address for the graphics resource to the graphics client,

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receive a command from the graphics client specifying the address, and
manage the graphics resource.

26. The graphics system of claim 25, wherein the kernel driver, when managing the
graphics resource, further causes the graphics processor to
determine if the graphics resource is available, and
page current data associated with the graphics resource to a backing store if the
graphics resource is not available.

27. The graphics system of claim 26, wherein the current data to page is determining
using paging criteria.

28. The graphics system of claim 27, wherein the paging criteria is selected from the
group consisting of a type of graphics resource, a priority, and a paging algorithm.

29. The graphics system of claim 28, wherein the paging algorithm is based on usage of
the graphics resource.

30. The graphics system of claim 25, wherein the kernel driver, when managing the
graphics resource, further causes the graphics processor to
detect a conflict if the graphics resource has been reused; and
resolve the conflict.

31. The graphics system of claim 30, wherein the graphics processor is associated with
a graphics hardware semaphore, and the kernel driver, when resolving the conflict, further
causes the graphics processor to
insert a reference to the graphics hardware semaphore before the command,
page the current data associated with the graphics resource to the backing store,

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6 page data for the graphics client from the backing store into the graphics resource,
7 and
8 clear the graphics hardware semaphore.

1 32. The graphics system of claim 25, wherein the kernel driver further causes the
2 graphics processor to record information about the graphics resource in an entry in a
3 virtualization map for use in allocating and managing graphics resources.

1 33. An apparatus for virtualizing graphics resources comprising:
2 means for receiving, by a graphics kernel, an allocation request for a graphics
3 resource from a graphics client;
4 means for allocating, by the graphics kernel, the graphics resource to the graphics
5 client;
6 means for returning, by the graphics kernel, an address for the graphics resource to
7 the graphics client;
8 means for receiving, by the graphics kernel, a command from the graphics client
9 specifying the address; and
10 means for managing, by the graphics kernel, the graphics resource.

1 34. The apparatus of claim 33, wherein the means for managing the graphics resource
2 comprises:
3 means for determining if the graphics resource is available; and
4 means for paging current data associated with the graphics resource to a backing
5 store if the graphics resource is not available.

1 35. The apparatus of claim 34, wherein the means for allocating the graphics resource
2 further comprises:
3 means for determining the current data to page using paging criteria.

1 36. The apparatus of claim 35, wherein the paging criteria is selected from the group
2 consisting of a type of graphics resource, a priority, and a paging algorithm.

1 37. The apparatus of claim 36, wherein the paging algorithm is based on usage of the
2 graphics resource.

1 38. The apparatus of claim 33, wherein the means for managing the graphics resource
2 comprises:
3 means for detecting a conflict if the graphics resource represented by the token has
4 been reused; and
5 means for resolving the conflict.

1 39. The apparatus of claim 38, wherein the means for resolving the conflict comprises:
2 means for inserting a reference to a graphics hardware semaphore before the
3 command;
4 means for paging the current data associated with the graphics resource to the
5 backing store;
6 means for paging data for the graphics client from the backing store into the
7 graphics resource; and
8 means for clearing the graphics hardware semaphore.

1 40. The apparatus of claim 33 further comprising:
2 means for recording, by the graphics kernel, information about the graphics
3 resource in an entry in a virtualization map for use by the means for allocating and the
4 means for managing the graphics resource.